viscous liquids are produced which remain liquid even at −10°. As regards the preparation of the base, M. de Bruyn has now succeeded in obtaining a hundred grams of the pure crystals from a little more than a kilogram of the hydrochloride, by the method described in our previous note above referred to.

THE additions to the Zoological Society's Gardens during the past week include a red and yellow macaw (*Ara macao*) from Central America, presented by the Rev. T. N. Talfourd Major; two gold pheasants (*Thaumalea picta* ♀ ♀) from China; an Alpine Chough (*Pyrrhocorax alpinus*), European, purchased.

OUR ASTRONOMICAL COLUMN.

COMET HOLMES (NOVEMBER 6, 1892).—The following ephemeris, taken from *Astronomische Nachrichten*, No. 3131, gives the position for Comet Holmes for the ensuing week:—

Berlin, Midnight.

1892.	R.A. (app.). h. m. s.	Decl. (app.). ° ′	Log *r*.	Log Δ.
Dec. 23	0 55 44	+34 19·2		
24	56 37	16·0	0·4050	0·3049
25	57 31	12·9		
26	58 27	10·0		
27	0 59 24	7·2		
28	1 0 22	4·5	0·4073	0·3167
29	1 1 21	34 1·9		

M. Deslandres, in *Comptes rendus* for December 12 (No. 24), informs us that on November 21 he obtained a photograph of this comet between 10h. 40m. and 11h. 20m. Paris mean time, showing distinctly "un commencement de dédoublement." Owing to the bad weather no other negatives were taken until December 10, but although the time of exposure was an hour, the comet's impression was not obtained, thus confirming the present eye observations that its intensity is slowly decreasing.

COMET BROOKS (NOVEMBER 20, 1892).—The following ephemeris of Comet Brooks is that obtained by Berberich, and varies a little from that given last week, as will be seen by comparing the values for December 22, with those given last week:—

Berlin, Midnight.

1892.	R.A. h. m. s.	Decl. ° ′	Log Δ.	Log *r*.	Br.
Dec. 22	14 26 9	+42 50·2			
23	14 33 28	44 40·4	9·9211	0·0880	5·59
24	14 41 35	46 34·4			
25	14 50 41	48 31·6	9·9013	0·0861	6·18
26	15 0 55	50 31·4			
27	15 12 26	52 32·9	9·8838	0·0845	6·75
28	15 25 30	54 34·5			
29	15 40 21	56 34·4	9·8694	0·0831	7·26

SWIFT'S COMET.—*Knowledge* for December 1 contains three most interesting photographs of Comet Swift, taken by Prof. Barnard at the Lick Observatory on April 4, 6, and 7 respectively. These photographs, which are obtained from the original negatives after an enlargement of 2¼ times, show what good photographic work can be done even with small instruments when exposures are somewhat lengthened. In this case a 6-inch Willard lens of 31 inch focal length was strapped on to the tube of a 6½-inch equatorial, and the exposures given amounted to 60, 65, and 50 minutes. The ordinary driving-clock, combined with a slight hand movement at the eye end, were all that was required to compensate for the diurnal and proper motion of the comet. The star trails on the plates pointed out then the comet's proper motion. Although these photographs were taken at such short intervals the changes recorded are most striking, the pictures bearing very little likeness to one another. On this point Prof. Barnard says: "Had they been drawn by the most competent observer, most astronomers would leave their remarkable differences to the unskilful hand of the artist, for there is absolutely no resemblance among them." The photographs here referred to are from a series taken at Mount Hamilton, and in examining them he mentions that in the case of this comet he has been led to forcibly believe that in a comparatively short period there occurred a rotation of the tail "upon an axis through the nucleus."

ULTRA-VIOLET SPECTRUM IN PROMINENCES.—In the current number of the *Memorie della Società Degli Spettroscopisti Italiani*, Prof. G. E. Hale communicates a note on some photographs of the ultra-violet region in the spectra of solar prominences. On October 15 at 3h. 15m. a photograph of the spectrum of a metallic prominence was obtained, which contained as many as 74 bright lines in the ultra-violet between wave-lengths 3970 and 3630. The photograph, besides displaying all the lines previously recorded by Prof. Hale and M. Deslandres, contained 32 additional lines which had not been previously known. The following table shows their respective wave-lengths, which are to be regarded yet as only approximate:—

λ	λ	λ
3964	3863	3724·3
3956·9	3850·5	3716·9
3945·2	3813·5	3710·3
3938·1	3774	3699·5
3913·5	3767·1	3683
3965	3758	3681
3895·5	3757	3679·5
3893·8	3749·7	3674·2
3891	3741·7	3662·2
3878·8	3733·3	3647·8
		3632
		3630·8

Besides these lines the photograph shows traces of the lines λ 3807·2, 3802, 3764, 3763, 3758·2, 3709·5, 3707·8, 3676, 3643.

EPHEMERIS FOR BODIES MOVING IN THE BIELA ORBIT.—In *Astronomical Journal*, No. 281, Dr. Chandler communicates an ephemeris for the use of those wishing to search for bodies which may be moving in the orbit of Biela's comet. The ephemeris is given for every eight days. It is based on the orbit obtained by Michez, who calculated the principal perturbations up to 1866. In the present computations Dr. Chandler has not taken into account any disturbance that may have been produced by the proximity of the planet Jupiter, or any perturbation that might have ensued from an approach to our earth. The values are given up to the end of February, 1893.

MADRAS MERIDIAN CIRCLE OBSERVATIONS.—The Government of Madras has lately issued the results of observations of the fixed stars, made with the meridian circle during the years 1874–76. During this interval no change whatever was made either in the instrument or in the methods of reduction. The volume gives the instrumental corrections for these years, the separate results of observations for each year, with the mean positions of the stars brought up to January 1 of each year, and corrections to the Nautical Almanac stars for the period in question.

THE JUBA RIVER.

AT the meeting of the Royal Geographical Society on Monday evening, Commander F. G. Dundas, R.N., read a paper describing his ascent of the Juba river. This was the first serious attempt to explore the river since Von der Decken's ill-fated expedition in the *Guelph* in August, 1865. The stern-wheel steamer *Kenia*, belonging to the Imperial British East Africa Company, under the command of Captain Dundas, crossed the bar of the Juba on April 25, 1892, an operation of much danger, as the vessel was exposed broadside on to heavy rollers; the depth at high water is only one fathom, and the water swarms with sharks and crocodiles. The coast Somalis lined the bank with hostile movements as soon as they saw that the vessel was to go up the river, and detained the expedition for a fortnight, until a message was sent to the head chief, the Sultan of the Ogaden Somalis. It was July 3 before amicable arrangements could be made, and the expedition fairly started. The Somalis met with everywhere were very strict Mohammedans, and secluded their women, but a number of Galla slave-girls were seen amongst them. There were few villages, Hajowan and Hajaualla opposite each other near the mouth being the only large ones until Munsur, 360 miles, and Bardera, 387 miles from the sea, were reached. The lower reaches of the river were very winding. On one occasion Captain Dundas observed a stream flowing parallel to the river he was on, and going across to see it recognized the landmarks as those

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he had passed three hours before. The Waboni tribe, who live by hunting, and use the bow and arrow, occupied the thick woods of the lower river. Above them the curves became more gentle, and the Gusha district was reached, where the people cultivated the land, which was cleared by burning; and for a hundred miles the *Kenia's* furnaces were fired with the dead trees which had been killed, but left unburnt by the fire. Cotton is cultivated as well as food plants, and there is a primitive system of weaving. Above Bilo, and about 100 miles from the sea, a branch was found to run off from the main river to the south-west through very dense forests. This is probably the Sheri, which reaches the sea midway between Lamu and Kismayu; the land between this and the Juba mouth being probably of deltaic origin. This branch was explored in a boat for twenty miles. The dense forests formed a broad belt on both sides on the river, and after steaming for five days through uninhabited woods the *Kenia* suddenly emerged into open country on August 2. The people were of very mixed race, friendly and well supplied with all sorts of food. Hills began to appear, and the river grew shallower, until on August 10 the steamer moored to the bank opposite Bardera. Here the Sultan forbad a landing, and the people, who numbered about 1200, were hostile, but ultimately peace was arranged, and one of the subordinate sheiks accompanied the *Kenia* to the rapids, where the river sweeps between steep rocky hills 300 to 400 feet high. There are three channels in the rapids, but at the time of the visit none was navigable, and the natives reported a waterfall over a ledge of rock about four hours' march further up, in latitude 2°34′ N. The wreck of the *Guelph* was visited and examined, but the rapid falling of the water made it necessary to hasten back to the sea. The climate throughout was found agreeable, and there were few mosquitoes. The river does not overflow, so there are no malarial swamps along the banks.

BREATH FIGURES.[1]

FIFTY years back Prof. Karsten, of Berlin, placed a coin upon glass, and by electrifying it made a latent impression, which revealed itself when breathed upon. About the same time Mr. W. R. (now Sir W. R.) Grove made similar impressions with simple paper devices, and fixed them so as to be always visible. A discussion of Karsten's results occurs in several places, but I have not been able to find details of his method of performing the experiment. During my attempts to repeat it some effects have appeared which seem to be new and worthy of record.

After many trials I found the following method the most successful:—A glass plate, six inches square, is put on the table for insulation: in the middle lies a coin with a strip of tinfoil going from it to the edge of the glass: on this coin lies the glass to be impressed, four or five inches square, and above it a second coin. It is essential to polish the glass scrupulously clean and dry with a leather: the coins may be used just as they usually are, or chemically cleansed, it makes no difference. The tinfoil and the upper coin are connected to the poles of a Wimshurst machine which gives three or four inch sparks. The handle is turned for two minutes, during which one-inch sparks must be kept passing at the poles of the machine. On taking up the glass one can detect no change with the eye or the microscope; but when either side is breathed upon, a clear frosted picture appears of that side of the coin which had faced it: even a sculptor's mark beneath the head may be read. For convenience those parts where the breath seems to adhere will be called white, the other parts black. In this experiment the more projecting parts of the coin have a black counterpart, but there is a fine gradation of shade to correspond with the depth of cutting in the device: the soft undulations of the head and neck are delicately reproduced.

The microscope shows that moisture is really deposited over the whole surface, the size of the minute water granulation increasing as the point of the picture is darker in shade.

There seems to be no change produced by the use of coins of different metals.

If sparking is allowed across the glass instead of at the poles of the machine, traces of metal are sometimes deposited beyond the disk of the coin, but not within it.

Around the disk is a black ring quarter inch broad: sometimes the milling of the coin causes radial lines across this halo.

If carefully protected there appears to be no limit to the permanence of the figures, but commonly they are gradually obscured by the dust gathered up after being often breathed upon: some of the early ones, done more than two years back, are still clear and well defined in the detail.

It is possible to efface them with some difficulty by rubbing with a leather whilst the glass is moist. They are best preserved by laying several together when dry and wrapping them in paper: they are not blurred by this contact.

It is a curious fact that certain developments take place after a lapse of some weeks or months. The dark ring around the disk gradually changes into a series of three or four, black and white alternately; other instances of such a change will be noted below.

Let it be noticed that in coin pictures the object is near to, but not in contact with, the glass: for in the best specimens the rim of the coin keeps the inner part clear of the surface.

Obviously a small condenser is made by the coins: it is not essential; at the same time images made by a single coin, put to a single pole, are inferior.

The plan which gives the surest and most beautiful results is to place five or six coins, lying in contact side by side in a cross or star, on either side of the glass: it is not necessary that each coin should exactly face one on the other side.

There has not appeared any distinction between the figures made by positive and negative electricity.

When several coins are placed side by side, touching one another, there appear in the spaces between them, which are mostly black, well-defined white lines, common tangents to the circular edges of the coins. If these are of equal size the lines are straight; otherwise they are curved, concave towards a smaller coin. They seem to be traces in that plane of the loci of intersection of equipotential surfaces.

Similar effects are obtained when coins and glasses are piled up alternately, and the outer coins are put to the poles of the machine. With six glasses and seven coins perfect images have been formed on both sides of each glass. With eight glasses the figures were imperfect; but there is little doubt this could be improved by continued trials as to the amount of electricity applied.

If several glasses are superposed and coins are applied to the outer surfaces, there are only the two images at the outside. After the electrification there is a strong cohesion between the plates.

It requires some practice to manage the electrification so as to produce the best results. There are two forms of failure which present interesting features. Sometimes a picture comes out with the outlines dotted instead of being continuous. At other times, if the electrification is carried too far, the impression comes out wholly black; but on rubbing the glass when dry with a leather the excess is somehow removed. Naturally it is difficult to rub down exactly to the right point, but I have succeeded on several occasions in developing from a blank all the fine detail of elaborate coins.

Here, again, we have another instance of the development by lapse of time, for an over-excited piece of glass usually gives a clear picture after an interval of a day or two.

Impressions from stereotype plates have been taken of which the greater part is legible: the distinctness usually improves after a few days. In default of a second plate, a piece of tin-foil about the same size should be put on the opposite side of the glass.

Sheet and plate glass of various thicknesses have been used without any noticeable change either in the treatment or the results.

I have put an impressed glass on a photographic plate in the dark, but did not get any result on developing: my imperfect skill in photographic matters leaves this experiment inconclusive.

Probably all polished surfaces may be similarly affected: a plate of quartz gives the most perfect images, which retain their freshness longer than those on glass.

Mica and gelatine give poorer results: it is not possible to polish the surface to the necessary point without scratching it.

On metal surfaces fairly good impressions can be produced if, as Karsten advises, oiled paper is put between the coin and the surface.

In the order of original discovery the figures noticed by Peter Riess should come first. He discusses a breath-track made on

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[1] Paper read by Mr. W. B. Croft before the Physical Society of London on June 24, 1892.

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